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FOR

Charging and Communication Cable System For A Mobile Computer Apparatus

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Charging and Communication Cable System

For A Mobile Computer Apparatus

This application is a continuation-in-part of application Ser. No. 09/668,123, filed Sep. 21, 2000.

FIELD OF THE INVENTION

The present invention relates to the field of mobile computer systems. In particular the present invention discloses a charging system that is designed for both desktop usage and usage while traveling.

BACKGROUND OF THE INVENTION

Handheld computer systems have become a standard business tool for traveling professionals. Handheld computer systems allow traveling professionals to access large amounts of personal information such as an address book, a personal calendar, and a list of to-do items. In particular, handheld computer systems based upon the PalmOS® from Palm Computing, Inc of Santa Clara, California have become the de facto standard of handheld computer systems. Most handheld computer systems are designed to synchronize information with a larger computer system such as a personal computer system.

The various owners of handheld computer system use their handheld computer systems in different manners. Some handheld computer system users work mainly with a desktop personal computer system but bring their handheld computer system when attending meetings. Other handheld computer system users constantly travel and rarely ever work in one place.

Furthermore, the personal computer systems owned by various handheld computer system users vary widely. Most handheld computer system users also use a desktop personal computer system. However, many use notebook personal computers. Some handheld computer system users use computer workstations such as those produced by Sun Microsystems, Inc. Other handheld computer system users do not use any other computer system at all.

It is impossible to accommodate the particular needs of all these different types of users with a single packaged handheld computer system product. However, it would be desirable to provide handheld computer system package that accommodates the needs of most of the potential purchasers with additional extra packages available for those users with less common requirements.

SUMMARY OF THE INVENTION

A charging and communication cable system for a handheld computer system is disclosed. The charging and communication cable system includes a first interface for connecting to the handheld computer system, a second interface for connecting to another computer system, and a third interface for coupling to a charger system. In one embodiment, the third interface used to couple to a charger system is the same as the interface on the handheld computer system such that the charger may be coupled to the charging and communication cable system or directly to the handheld computer system.

Other objects, features, and advantages of present invention will be apparent from the company drawings and from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features, and advantages of the present invention will be apparent to one skilled in the art in view of the following detailed description in which:

Figure 1A illustrates a front view of a prior mobile computer system with an open external peripheral interface.

Figure 1B illustrates a back view of a prior mobile computer system with an open external peripheral interface.

Figure 2A is a front isometric view of an integrated stylus-based handheld computer and cellular telephone system.

Figure 2B is a rear isometric view of an integrated keyboard-based handheld computer and cellular telephone system.

Figure 3A illustrates an embodiment of a USB Charger/Communication cable system.

Figure 3B illustrates an embodiment of a USB Charger/Communication docking cradle system.

Figure 4A illustrates an embodiment of a serial data-communication/charger system.

Figure 4B illustrates a serial docking cradle Charger/Communication system.

Figure 5A illustrates a USB data-communication/charger cable with an associated docking cradle

Figure 5B illustrates a serial data-communication/charger cable with an associated docking cradle

Figure 6A illustrates an embodiment of a USB Charger/Communication cable system that uses an off-the-shelf power supply.

Figure 6B illustrates an embodiment of a USB Charger/Communication docking cradle system that uses an off-the-shelf power supply.

Figure 7A illustrates an embodiment of a serial Charger/Communication cable system that uses an off-the-shelf power supply.

Figure 7B illustrates an embodiment of a serial Charger/Communication docking cradle system that uses an off-the-shelf power supply.

Figure 8 illustrates a first embodiment of charging circuitry for a handheld computer system.

Figure 9A illustrates an improved embodiment of charging circuitry for a handheld computer system.

Figure 9B illustrates a conceptual diagram of the charging circuitry of **Figure 9A** that explains how leak current may power the LED.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A method and apparatus for constructing a portable computer system that can easily be expanded to handle many new add-on peripherals is disclosed. In the following description, for purposes of explanation, specific nomenclature is set forth to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the present invention. For example, the present invention has been described with reference to the Handspring™ Springboard™ peripheral interface. However, the same techniques can easily be applied to other types of peripheral interfaces.

Handheld Computer Systems

Figures 1A and **1B** illustrate a typical handheld computer system **100**. As illustrated in **Figure 1A**, the mobile computer system includes a display area **120** for displaying information. The display area **120** is covered with a digitizer panel for entering information into the mobile computer system **100** using a stylus. The mobile computer system **100** further includes a set of external buttons **130** that may also be used to enter user input.

The handheld computer system **100** illustrated in **Figures 1A** and **1B** is provided as an example only. Many different variations of handheld computer system exist. For example, other handheld computer systems may have built-in wireless digital network communication systems, large keypads, or may be combined with cellular telephone circuitry.

The handheld computer system **100** has an external interface **180** as illustrated in **Figure 1A**. The external interface **180** may be used for communicating with external devices. Most current handheld computer systems use such an external interface **180** to communicate with a personal computer system. In this manner, the owner of handheld computer system **100** can share data between the handheld computer system **100** and the personal computer system.

The external interface **180** may also be used for supplying power to the handheld computer system **100**. For example, the handheld computer system **100** may include an internal battery for powering the handheld computer system **100**. If power is supplied to the handheld computer system **100** through external interface **180**, the handheld computer system **100** may use the power from the external interface **180** instead of power from an internal battery. If the internal battery is rechargeable, the handheld computer system **100** may charge the battery when power is supplied to the handheld computer system **100** through external interface **180**.

Many handheld computer systems are sold with a docking cradle that mates with the external interface **180** of the handheld computer system and connects to a desktop personal computer. The docking cradle is then coupled to a personal computer system using one of the popular personal computer system interfaces. Possible computer system interfaces include IEEE 1394, universal serial bus (USB) interface, and the older RS-232 serial interface. The docking cradle may also be used to charge the internal batteries of the handheld computer system by drawing power from the personal computer system or an external power supply.

More recent handheld computer systems incorporate wireless communication circuitry such that the handheld computer systems become personal communication devices that are carried with the user. Such wireless communication enabled handheld computer systems may act as a cellular telephone, a text-messaging device, an Internet browsing terminal, an email terminal or all of these things.

Figures 2A and **2B** illustrate one embodiment of an integrated handheld computer and cellular telephone system **200**. The integrated handheld computer and cellular telephone system **200** includes a keyboard **230** such that the user may easily enter names, addresses, phone numbers, and email messages into application programs running on the integrated handheld computer and cellular telephone system **300**.

With such wireless mobile communication abilities, a user will likely carry the handheld computer system around all the time. Thus, the need for more portable charging and synchronization systems exists.

Charger/Communication Cable Systems

Figure 3A illustrates a first embodiment of a Charger/Communication cable system. Referring to **Figure 3A**, a handheld computer system **310** has an electrical interface **311** for receiving electrical power and data communication signals. To provide power to the electrical interface **311** of handheld computer system **310**, a charger and communication cable system is provided. The charger and communication cable system

consists of a Universal Serial Bus (USB) data-communication/charger cable **320** and a charger cable **330**.

The USB data-communication/charger cable **320** has been designed to couple the handheld computer system **310** to another computer system (not shown). The USB data-communication/charger cable **320** couples the electrical interface **311** on the handheld computer system **310** to a Universal Serial Bus (USB) interface on another computer system (not shown). Specifically, interface connector **321** on USB data-communication/charger cable **320** couples USB signals to a USB connector **325** on data-communication/charger cable **320**. Interface connector **321** may include a synchronization button **322** that can be used to indicate when a user wishes to have the handheld computer system **310** synchronize its databases with another computer system (not shown) coupled to USB connector **325**.

The charger cable **330** comprises a power supply **331** and an interface connector **337** for coupling the power supply **331** to the handheld computer system **310**. The power supply **331** may be comprised of a transformer and other electronics necessary to covert a local AC line current into a desired DC power current for the handheld computer system **310**. Many different types of charger cable **330** embodiments may be created to adapt for the different AC line currents in different countries (i.e. 120 Volt / 60 Hz or 220 Volt / 50 Hz) and the different physical AC connectors used by different countries around the world.

When USB data-communication/charger cable **320** is coupled to the interface **311** on handheld computer system **310**, charger cable **330** can provide power to

the handheld computer system **310**. Specifically, interface connector **337** of charger cable **330** may be coupled to interface **329** on electrical power connector **327** of USB data-communication/charger cable **320**. Interface **329** on electrical power connector **327** of USB data-communication/charger cable **320** carries power from power supply **331** to the handheld computer system **310**.

If the user of the handheld computer system **310** is traveling with out his personal computer, the user may elect to travel only with the charger cable **330** since the USB data-communication/charger cable **320** will not be needed. In such a circumstance, the user may connect the charger cable **330** to the handheld computer system **310** by coupling interface connector **337** directly to the electrical interface **311** of handheld computer system **310**. The charger cable **330** carried by the traveling user may have different adapters and settings to allow it to operate with the different AC line currents in different countries and the different physical AC connectors used by different countries.

If there is a manner in which a user may misuse a device, such a misuse will generally eventually occur. With regard to USB data-communication/charger cable **320**, a user may inappropriately connect the interface connector **321** end of data-communication/charger cable **320** to the electrical power connector **327** end of USB data-communication/charger cable **320**. To prevent damage, interface **329** of electrical power connector **327** only contains conductors for electrical power such that no damage will occur if a user connects interface connector **321** to the electrical power connector **327** even if the USB connector **325** is connected to an operating personal computer system (not shown).

Figure 3B illustrates an alternate embodiment of the Charger/Communication cable system of **Figure 3A**. In the embodiment of **Figure 3B**, a serial docking cradle **353** is provided to allow the handheld computer system **310** to rest in the serial docking cradle **353**. When handheld computer system **310** rests in serial docking cradle **353**, the electrical interface **311** of handheld computer system **310** mates with the electrical interface **351** of serial docking cradle **353**. This connection allows data communication with USB connector **355** and the power input through electrical power connector **327**.

<u>Serial Interface</u>

Not all personal computer systems have USB communication ports. Furthermore, some operating systems do not adequately support the USB communication ports available on personal computer systems. To allow users in such predicaments use a handheld computer system, **Figures 4A** and **4B** provide a serial communication port versions of the Charger/Communication cable system.

Figure 4A provides a serial data-communication/charger cable **420** that is similar to the USB data-communication/charger cable **320** of **Figure 3A**. The principal difference between serial data-communication/charger cable **420** and USB data-communication/charger cable **320** is that serial data-communication/charger cable **420** connects a serial port on handheld computer system **410** to a serial port on a personal computer system (not shown) using a serial connector **425**.

Figure 4B illustrates a serial docking cradle **453** for serial data communication and charging of a handheld computer system. The principal difference

between serial docking cradle **453** and serial docking cradle **353** of **Figure 3B** is that serial docking cradle **453** connects a serial port on handheld computer system **410** to a serial port on a personal computer system (not shown) using a serial connector **455**.

Combined Travel/Docking System

Figures 5A and **5B** illustrate alternate embodiments that combine the advantages of the previous embodiments. Specifically, **Figures 5A** and **5B** provide both a docking cradle for normal office usage and a travel data-communication/charger cable for use while traveling.

Figure 5A illustrates a USB data-communication/charger cable **520** that includes a connector **522** for coupling directly to a handheld computer system (not shown). When a handheld computer system is coupled to connector **522**, the handheld computer may communicate with a personal computer system (not shown) coupled to connector **525** and receive power from charger **560** coupled to connector **529**.

If the user wishes to use a docking cradle for normal office usage, the user may obtain docking cradle **583**. Connector **522** of USB data-communication/charger cable **520** couples with interface **582** on the docking cradle **583**. Interface **582** carries the electrical signals from connector **522** to an interface **581** on the docking cradle such that a user may easily couple a handheld computer system (not shown) to a personal computer and a charging system **560** by simply dropping the handheld computer system into the docking cradle **583**.

Figure 5B illustrates the same arrangement as **Figure 5A** except that the USB data-communication/charger cable **520** has been replaced with a serial data-communication/charger cable **550**. In this manner users that do not have a personal computer system with USB support can instead use a serial port connected to serial connector **555**.

Note that the same docking cradle **583** may be used with both the USB data-communication/charger cable **520** and the serial data-communication/charger cable **550**. In this manner, the handheld computer system may be sold with either the USB data-communication/charger cable **520** or the serial data-communication/charger cable **550**. The purchasers of either those systems that desire a docking cradle may purchase the same optional docking cradle **583**.

System with off-the-shelf power supply

To reduce the cost, an off-the-shelf power supply may be used instead of using a power supply with a special connector. **Figures 6A** and **6B** illustrate an USB embodiment that uses an off-the-shelf power supply **660**. In the embodiment of **Figure 6A,** the power supply connects to the USB connector **625** to supply power to a USB data-communication/charger cable **620**.

Figure 6B illustrates a docking cradle embodiment that uses an off-the-shelf power supply **660**. In another docking cradle embodiment (not shown), a user may purchase an optional docking cradle **583** such that connector **621** of USB data-communication/charger cable **620** may be coupled to interface **582** of docking cradle **583**.

Figures 7A and **7B** illustrate serial interface embodiments similar to the USB embodiments of **Figures 6A** and **6B**. A user with the serial data-communication/charger cable **720** of **Figure 7A** may also use docking cradle **583** to obtain cradle functionality.

Charger Circuitry Systems

To charge a rechargeable internal battery in a handheld computer system, the handheld computer system usually contains dedicated charging circuitry. The charging circuitry monitors various battery conditions and determines when a charge is needed and when the battery is fully charged.

Figure 8 illustrates one embodiment of charging circuitry for a handheld computer system. In the charging circuitry of **Figure 8**, an external electrical interface V_{dock} **830** is connected to a charging control circuitry **820**. When the handheld computer system is placed in a charging docking cradle or otherwise connected to a charging source, charging control circuitry **820** detects a charging voltage on electrical interface V_{dock} **830** and begins to charge the battery **860**. The charging control circuitry **820** informs processor **810** such that the system may make necessary user interface adjustments.

In an alternate embodiment, charging control circuitry **820** detects a charging voltage on electrical interface V_{dock} **830** and informs the processor **810**.

Processor **810** then determines that the battery **860** needs to be charged and instructs charging control circuitry **820** to charge the battery **860** if necessary.

The charging control circuitry **820** charges battery **860** by activating transistor **850** which supplies current from the external charging voltage on electrical interface V_{dock} **830** to battery **860**. In one embodiment, the charging control circuitry **820** charges the battery **860** over a three hour period. In a Lithium Ion battery embodiment, the charging begins a constant current "fast charge." As the charging nears completion (ninety percent charged in one embodiment), the charging control circuitry **820** slows the charging current down and uses a constant voltage "trickle charge."

The charging current also lights Light Emitting Diode (LED) **880** to inform the user that the battery is being charged. The processor **810** may control LED **880** during charging using transistor **890**. In a preferred embodiment, the processor **810** may cause LED **880** to blink by consecutively turning on and off transistor **890** during the main charging phase. This informs the user that the battery is being charged. Once the charging is complete (or near complete), the processor **810** may cause turn on LED **880** by turning on transistor **890**. In a preferred embodiment, the processor **810** blinks the LED **880** during the "fast charge" phase and then turns on LED **880** for a steady output during the "trickle charge" phase. If the user unplugs the charger before the trickle charge is complete, the user interface will calibrate itself to use the current charge status as the 100% charged state.

Silent Alarm

Processor **810** may use control LED **880** after charging is complete by using transistor **890**. In this manner, processor **810** may use LED **880** to output information to the user. In a preferred embodiment, the system software may be modified to allow the user to select a "silent alarm" mode. In the silent alarm mode, the operating system of the handheld computer system will not emit audible alerts when programs request an alarm to be generated but will instead generate a "silent alarm" by blinking LED **880**. In this manner, the handheld computer system will be able to notify the user of an event without emitting a disruptive audible alarm during a meeting.

One problem with the charging circuitry of **Figure 8** is that when charging control circuitry **820** has fully charged battery **860**, then charging control circuitry **820** will turn off transistor **850** such that LED **880** begins to drain battery **860**. Thus, battery **860** begins to discharge even though external power is available through electrical interface V_{dock} **830**. To prevent such discharging, the processor may turn off transistor **890**. However, such an implementation would provide ambiguous feed back to the user. Specifically, the user would not know if the charging is complete or if the charger system was not properly plugged into an AC outlet.

Revised Charging and LED control circuitry

To remedy this situation, **Figure 9A** illustrates an alternate charging circuitry embodiment. In **Figure 9A**, the power source of LED **980** has been moved above transistor **950**. In this manner, when the charging control circuitry **920** has fully charged battery **960**, then charging control circuitry **920** will turn off transistor **950** such that LED **980** is powered by the external power available through electrical interface

V_{dock} **930**. Thus, LED **980** does not drain battery **960** after it has become charged. Note that processor **910** can still control LED **980** during charging using transistor **990**.

The system of **Figure 9A** provides all the same features as the system of **Figure 8** during charging. However, it might appear slightly less useful than the system of **Figure 9A** when the handheld computer system is disconnected from the charging source and operating on battery **960** power. Specifically, it might appear that LED **980** cannot be used when operating only from battery power. However, this is not true due to the design of transistor **950**. Specifically, transistor **950** is implemented with a transistor that contains a diode across the drain and the source such as Motorola's MGSF1P02LT1 P-Channel enhancement-mode TMOS MOSFET transistor.

Figure 9B illustrates a diagram of such an embodiment. In the embodiment of **Figure 9B**, when charging control circuitry **920** turns off transistor **950**, current may flow from battery **960**, up through diode **955**, through LED **980**, and down through transistor **990**. Therefore, even though transistor **950** has been turned off, processor **910** can control LED **980** using transistor **990**.

Thus, in the embodiment of **Figure 9B**, LED **980** is only powered by the power received from electrical interface V_{dock} **930** during charging. But when there is no charging voltage on electrical interface V_{dock} **930**, then LED **980** is powered by the battery **960**. In either case, processor **810** can control LED **980** by controlling transistor **990**.

The foregoing has described a portable computer system that can easily be expanded to handle many new add-on peripherals is disclosed. It is contemplated that

changes and modifications may be made by one of ordinary skill in the art, to the materials and arrangements of elements of the present invention without departing from the scope of the invention.